REMARKS

The present amendment enhances the definition of Applicant's invention with a view to clarify distinctions between both the Mozzo and Martin references applied by the Examiner in the final office action. Various claims have been amended for minor matters of clarity that should be apparent from the amendments with explanation. The amendments to claims 25, 40 and 53 are explained below.

Claim amendments – Claim 25

In independent claim 25, the following limitations are added by way of the present amendment.

Firstly, "in which process at least some of said parameters X_i involved exhibit interfering effects on the desired properties Y_j" has been added to the preamble of the claim. This expression is found in the specification at page 1, line 20, and is consistent with the remainder of the specification.

Secondly, the step of "identifying an expected operational range of said process within which an optimal parameter value is likely to be found for each of said set of parameters X_i, and selecting given parameter data for obtaining experimentally associated property data", is supported by the specification at page 11, lines 11 to 17.

Thirdly, it has been clarified that the property behavior mathematical relations are established "for each one of said set of k properties Y_j characterizing the product". While this should have been implicit in the original claim 25, it is presently amended for certainty. Furthermore, claim 25 has been amended to preclude the possibility that the language of the claim could be interpreted to understand that each property being weighted could be distinct values of a same property, as is the case in the Martin reference. The property behavior relations are established to provide estimated property values in terms of the parameters X_i within the operational range. It is thus clear that the term property relates to a quantity that is the same when only differing by a value thereof.

Fourthly, the expression "said given parameter data and associated property data being essentially statistically insufficient for the purposes of quantifying said property behavior mathematical relation in the case that said relation is to be used to find optimal parameter values for said process to be optimized for only one of said set of k properties Y_j characterizing the product" is supported generally by the specification with regard to the characterization of the prior on page 2, lines 6 to 8 as "These techniques aim at (sic, it should read "to") quantify existing relations between

parameters and associated desired product performance characteristics.", and then with regard to the disclosure of using n+1 experimental runs, where n represents the number of independent parameters, found in the examples in the preferred embodiment. The invention as disclosed in the specification relates to optimization that does not seek to quantify from experimental data the property behavior relations in a manner that will find optimal parameter values. But rather, as defined in the first step, the expected operation range of the process within which the optimal parameter value is likely to be found is identified, and the property behavior relation derived from the experimental data is sufficient via the goal function for finding the optimal set of parameter values. It will be appreciated, that if the invention operates in the case that n+1 experimental runs have been done and there are n independent parameters, that the invention operates under conditions that the property behavior relations are statistically insufficient for the purposes of finding optimal parameter values.

Fifthly, it has been made explicit that "said property behavior mathematical relations for said set of k properties Y_j characterizing the product" are used to establish the goal function. It is believed that this limitation was clearly understood from original claim 25 and has been inserted for certainty.

Lastly, it has been made explicit that the "property behavior mathematical relations for said set of k properties Y_j characterizing the product are sufficient for the purposes of establishing said goal function". It is believed that this limitation was clearly understood from original claim 25 and has been inserted for certainty.

Claim amendments – Claim 40

Firstly, it has been defined in the preamble that the number of process parameters is greater than two. This is supported by the examples in the specification.

Secondly, "in which process at least some of said parameters X_i involved exhibit interfering effects on the desired properties Y_j" has been added to the preamble of the claim. This expression is found in the specification at page 1, line 20, and is consistent with the remainder of the specification.

Thirdly, the chosen range of values for each one of the parameters X_i defined in the step of conducting a number of l of experimental runs of the process has been defined as "corresponding to an expected operational range of said process within which an optimal parameter value is likely to be found for each of said set of parameters X_i". This feature is supported by the specification at page 11, lines 11 to 17.

Fourthly, the limitations of original claim 42 have been brought into claim 40, while claim 40 has been cancelled. In addition to the limitations of claim 42, it has

been made explicit that "said property behavior mathematical relations for said set of k properties Y_j characterizing the product" are used to establish the goal function. It is believed that this limitation was clearly understood from original claim 42 and has been inserted for certainty. Furthermore, it has been made explicit that the "property behavior mathematical relations for said set of k properties Y_j characterizing the product are sufficient for the purposes of establishing said goal function". It is believed that this limitation was clearly understood from original claim 42 and has been inserted for certainty.

Furthermore, claim 40 has been amended to preclude the possibility that the language of the claim could be interpreted to understand that each property being weighted could be distinct values of a same property, as is the case in the Martin reference. The property behavior relations are established to provide estimated property values in terms of the parameters X_i within the chosen range. It is thus clear that the term property relates to a quantity that is the same when only differing by a value thereof.

Claim amendments – Claim 53

This claim is dependent on claim 25 has been added to define that the number of process parameters is greater than two. This is supported by the examples in the specification. Claims 28 and 34 have been amended to depend from this claim.

Comparison of Applicant's Invention with Prior Art of Record

Applicant's invention as defined in claim 25 or in claim 40 distinguishes from the prior art, for example Mozzo and Martin, in that the method relates to optimization using property behavior mathematical relations that are based on a reduced number of experimental runs such that these relations cannot be used to find or search for optimal values. In claim 25, this feature is expressed by the combination of the step of "identifying an expected operational range of said process within which an optimal parameter value is likely to be found for each of said set of parameters X_i" and the fact that "said given parameter data and associated property data being essentially statistically insufficient for the purposes of quantifying said property behavior mathematical relation in the case that said relation is to be used to find optimal parameter values for said process to be optimized for only one of said set of k properties Y_j characterizing the product". In claim 40, the latter limitation is expressed by the limitation "wherein l is at least equal to $n + 1$ and is substantially less than a number used in the Fractional Factorial Matrix method", while the former limitation has been incorporated into the first step of claim 40.

In Mozzo, we find one example disclosed (Example 2) in which the number of experimental runs is merely one more than the number of parameters. The Fractional Factorial Matrix method would indicate in this case that the number of experimental runs required for establishing the property behavior relation is 4, and thus Mozzo does not teach using a number of experimental runs less than a number used in the Fractional Factorial Matrix method, as defined in claim 40. Mozzo also cannot work unless the property behavior relations are statistically sufficient, thus using experimental parameters dictated by the Fractional Factorial Matrix method.

Mozzo teaches a technique for reducing the calculation time to find the optimum set of parameter values. In Figures 1 to 4 of Mozzo, there is illustrated an example showing the values of property P1 (Fig. 1) and of property P2 (Fig. 2) as a function of two parameters V1 and V2. In the case that the desired property values for P1 and P2 are 50 and 15 respectively, the curves shown in Figure 3 can be used in a manual method to find the intersection at point C. The parameter values at point C are the optimal parameter values. The invention in Mozzo simplifies a numerical method for finding point C, and is schematically illustrated in Figures 5 to 8. The property behavior relations were established using the experimental data to enable determination of the property values illustrated in Figures 1 and 2. Using those relations, values are calculated at the points 1 to 4 illustrated in Figure 5. These points are chosen as being a frame R1 within the full range of possible values. Having determined that point 2 is closest to the optimum value C, namely because an error between the calculated values of P1 and P2 and the goal values for P1 and P2 is lower, point 2 becomes the center of the next hypercube frame R2, and points 5 to 8 are chosen. Again the relations are used to calculate the P1 and P2 values for points 5 to 8. It is then determined that point 8 is closest to point C, and the coordinates of point 8 become the center of the next hypercube frame R3 having points 9 to 12, as shown in Figure 7. This process continues until the values of P1 and P2 for the four corners of the hypercube frame are within tolerance of the goal values for P1 and P2 (Figure 8).

Mozzo teaches that the hypercube approach reduces the number of computations required to reach the value of C. The technique can be compared to the well-known Newton method for finding a square root, in that it is a technique for converging on an answer that is faster than a brute-force approach of calculating all values until an answer is found. For the technique taught by Mozzo to find the optimum point C, the property behavior relations shown graphically in Figures 1 and 2 must be accurately known and statistically sufficient, for example, the relations illustrated in Figures 1 and 2 are not linear and allow the optimum point C to be found.

In the Martin reference, models are used to simulate system behavior as a function of parameter values. Such models are built to determine accurately each property value as a function of input parameter values, and are statistically sufficient. Sufficiency or accuracy for determining a set of optimized parameter values for the weighted combination of property values is not an issue in the Martin reference, as it is required to be sufficient and accurate for each property. There is no disclosure in the Martin reference that weighting is to be applied to determine optimum parameter values related to plural properties.

In Applicant's invention, it has been discovered that the complex problem of optimizing parameter values, in cases where there are many parameters and properties with at least some parameters exhibiting interfering effects on the properties, can be simplified if a few elements are respected. Firstly, knowledge of the optimizer is used to identify an expected operational range of the process within which an optimal parameter value is likely to be found for each of the set of parameters. Secondly, knowledge of the optimizer is used to weight the relative importance of the properties. With the first element respected, the property behavior relations can be statistically insufficient for finding the optimum parameter values, even if insufficient for the usual optimization purpose of finding optimal parameter values. This is so because the use of the goal function with weighted properties yields a reliable answer for the parameter values.

The first step according to Applicant's invention is to accept that one works within the expected operational range. When performing optimization in the prior art, an optimizer determines the property behavior relations with sufficient accuracy to show what parameter values yield the best property values. Even if one has typically found best results within a certain range of parameters, the experimental design will need to confirm that the range of parameters will yield the best results. In Applicant's invention, such confirmation is not obtained, and the identification of the operation range is used as a starting point. The goal function is then used to find the optimal parameter values using the property behavior relations and relative property weights. There is no suggestion in the prior art that property behavior relations that are insufficient to determine or find optimal parameter values can serve any useful purpose.

In the prior art, if the experimental data is restricted to the expected operational range, accurate determination of a property behavior relation is compromised, as the trend of the relation over a greater range outside of the expected range will remain unknown. And, as mentioned, such accurate determination is necessary in the prior art to confirm or find the operational range containing optimal values, and in particular to find optimal parameter values.

It will be appreciated that Applicant's invention runs counter to conventional optimization practice. The property behavior relations used in Applicant's invention are too weak to be useful to confirm that the operational range contains optimum parameter values. Careful relative weighting of properties is used in the goal function to achieve a set of optimum parameter values in a method that leverages the optimizer's knowledge and experience about the operational range of parameters and the relative importance of properties. The very weak statistical basis, namely a number of experimental runs less than what is considered sufficient for optimizing single properties, is compensated by careful exploitation of the optimizer's knowledge.

In view of the foregoing, reconsideration of the rejection and allowance of claims 25 to 41 and 43 to 53 is respectfully requested.

Respectfully submitted,

James Anglehart (Reg. 38,796)
Agent of record

CUSTOMER NO. 020988

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